



Conserve O Gram

July 1993

Number 2/4

Dichlorvos (Vapona) Update

Dichlorvos ($C_4H_7Cl_2O_4P$) is a fumigant insecticide. This compound has been approved by the United States Environmental Protection Agency (EPA) for use as a museum fumigant since 1981. As an organophosphorus insecticide, it was first marketed by the Shell Corporation under the trademark Vapona.[®] Vapona was registered for pesticide use in 1960, followed by the Shell No-Pest Strip in 1963. The commercial pest strip contains the active ingredient within a plasticizer (e.g., polyvinyl chloride). The plasticizer component is designed to extend the fumigant's release time. Studies conducted by the Carnegie Museum of Natural History (the results were published in *Curator*, Vol. 32, No. 1, March 1989) have indicated that Vapona pest strips are effective in controlling insects. *However, these studies also have confirmed that this material can cause serious damage to museum objects.*

Properties

- Colorless to mild amber; non-flammable; mild chemical odor
- Poor warning properties
- Heavier than air in vapor state
- Highly dangerous concentrate; much safer as an impregnated strip form

Synonym (Chemical Name)

- 2,2-dichlorovinyl dimethyl phosphate

Trade Names

- AL-20, Vapona strips, 738 Vapona strips,

DDVP, vaponite, Nuvan

Health-Related Effects¹

- *Routes of Entry:* Skin absorption, inhalation, ingestion
- *Organs Affected:* Central nervous system
- *Acute Effects (short-term):* Range from mild to severe—inability to walk, chest discomfort, constriction of pupils, muscular twitching, unconsciousness, and seizures
- *Chronic Effects (long-term):* Slowness of thinking, memory defects, irritability, and delayed reaction times
- *Carcinogenic Effects:* Available test data under review by EPA²
- *Reproductive Effects:* Suspected human teratogen, causes birth defects and fetal death in laboratory rats

OSHA Standard³

Permissible Exposure Limit (PEL): 1 milligram dichlorvos per cubic meter of air (1 mg/m^3) as an 8-hour time-weighted average (8-hour TWA).

Short-term Exposure Limit (STEL): 1 mg/m^3 averaged over a 15-minute period.

Skin Designation: Readily absorbed through the skin. (NOTE: Standard states that an employee's skin exposure to this substance shall be prevented or reduced through the use of gloves, coveralls, goggles, or other appropriate

equipment, engineering controls, or work practices.)

Effectiveness

The studies conducted by the Carnegie Museum Natural History, Pittsburgh, PA, indicated that dichlorvos is effective in controlling insects at all of the life stages (e.g., egg, larva, pupa, and adult).

NOTE: The eggs need to be exposed to this fumigant for their entire incubation period. Therefore, it is essential that the target pest be identified. In order to be an effective fumigant, dichlorvos must be systematically adjusted to the *specific target pest and the museum collection's environmental conditions* (e.g., relative humidity and temperature). The fumigant's effectiveness depends on *accurate* knowledge of the target pest's life cycle in order to give enough time exposure to extend through its egg incubation period. Use of Vapona strips in high temperature and low relative humidity (e.g., 55% RH) gives the best results. The higher temperature causes the increased diffusion of the fumigant and the increased respiration of the target pest.

Reactivity

The Carnegie Museum studies confirmed suspicions that excessive exposure to the fumigant because of length of exposure time or fumigant concentration can cause serious deterioration of museum objects. It bleaches color, corrodes metals, weakens the structure of cellulose materials (e.g., paper and textile objects), decreases the pH of organic materials, moves oils and fats to the surface of leather and skin objects causing darkening and a greasy appearance, damages paint surfaces, and causes tackiness of some adhesives. In addition, objects that have been treated with other types of fumigant/pesticide materials (e.g., thymol) can be damaged when exposed to Vapona.

Conclusions

1. In order for dichlorvos to be effective, it must be used under controlled conditions in a properly sealed fumigation chamber that provides for safe ventilation. Without extensive modifications, a standard NPS museum storage cabinet is *not* appropriate for this use. (Refer to NPS *Museum Handbook*, Part I (Rev 9/90), Chapter 11, for guidance on fumigation.)
2. The length of exposure time to this fumigant is a concern. Dichlorvos is *highly reactive* with many museum materials. The longer the exposure time, the more possible that serious damage to objects may occur. It is essential that the target insect's life cycle be defined and understood before starting fumigation.
3. As with all pesticides, any use of dichlorvos *must be approved* by the NPS Integrated Pest Management (IPM) Coordinator, Washington Office, via the Regional Curator and the Regional IPM Coordinator. (Refer to the NPS *Museum Handbook*, Part I (Rev 9/90), Chapter 5, for guidance on obtaining approval to use fumigants/pesticides on museum objects.)
4. Read Material Safety Data Sheets (MSDS) prior to using this material. See *Conserve O Gram 2/1*. When handling this fumigant wear latex gloves, smock or apron made of impervious material (e.g., rubber), goggles, and a respirator. The respirator *must* provide specific protection against the agent's chemical classification. In consultation with the Park Safety Officer, select a respirator from the list of National Institute for Occupational Safety and Health (NIOSH) approved respirators.
5. Because of its reactivity with museum objects and health dangers, dichlorvos should only be used in controlled conditions and only when there is no other acceptable material.

Notes

1. Perri Peltz and Monona Rossol, *Safe Pest Control Procedures for Museum Collections* (New York: Center for Occupational Hazards [now the Center for Safety in the Arts], 1983).
2. The National Cancer Institute (NCI) has conducted tests to determine the carcinogenic potential of dichlorvos. The EPA has the test results under review. At the present time, the product's label does not require any carcinogenic precautions.
3. *Code of Federal Regulations*, Title 29, Chapter XVII, Part 1910.1000 - Occupational Safety and Health Standards, Subpart Z: "Toxic and Hazardous Substances," p. 15.

References

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